Waves

8-6 The student will demonstrate an understanding of the properties and behaviors of waves. (Physical Science)

8.6.5 Explain hearing in terms of the relationship between sound waves and the ear.
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 3rd grade (3-5.5), students recalled that vibrating objects produce sound and that vibrations can be transferred from one material to another. Students have not been introduced to the concepts of sound waves or their interactions with the ear in previous grades. Students will further develop the concepts of sound waves in high school Physical Science (PS-7.7).

It is essential for students to know the relationship between the ear and sound waves to explain hearing as follows:

- Sound waves are gathered by the *outer ear* which is shaped to help capture the sound waves (energy transferred in particles of air) and send them through the ear canal, which transfers them to the eardrum.
- The vibrations of air particles cause the eardrum to vibrate.
  - If the vibrations follow each other slowly (low frequency) the sound is heard as a low pitch. If the vibrations follow each other in rapid succession (high frequency), the sound is heard as a high pitch.
  - Sound waves with large amplitudes push on the eardrum with more force and are heard as loud sounds. Sound waves with small amplitudes push on the eardrum with less force and are heard as soft sounds.
- Vibrations from the ear drum are transmitted to three small bones of the *middle ear*, which transmit the vibrations to the inner ear.
- The vibrations in the liquid of the *inner ear* cause the tiny hairs to vibrate. The vibrating tiny hairs transmit the energy to nerves attached to the hairs.
- The nerve impulses are transmitted to the brain and interpreted as hearing.

It is not essential for students to know the specific anatomy of the three main parts of the ear in more detail than what is listed above (for example, names of ear bones).

Assessment Guidelines:
The objective of this indicator is to *explain* hearing in terms of the relationship between sound waves and the ear; therefore, the primary focus of assessment should be to develop a cause-and-effect model that shows the functions of the three main parts of the ear and how they transmit and transfer sound waves for hearing to occur in the brain. However, appropriate assessments should also require students to *recognize* the three major parts of the ear; *summarize* how the major parts of the ear transfer sound waves to the brain for interpretation; or *interpret* a diagram of the ear that depicts how sound is transferred and transmitted at each part.